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ON *CÆLOPISTHIA NEMATICIDA* PACK., A CHALCID PARASITE OF THE LARGE LARCH SAWFLY, *LYGÆONEMATUS ERICHSONII* HARTIG.*

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In the course of a study of the European and North American parasites of the Large Larch Sawfly, *Lygæonematus erichsonii* Hartig, which was begun several years ago, observations have been made on the life-history of this Chalcid parasite. Its abundance in the cocoons of *L. erichsonii* kept under observation would indicate that it is an important factor in the natural control of the sawfly in the Eastern States and Canada, and for this reason and also because hitherto it has been undescribed, the present account is written.

Packard† first referred to this parasite in the account of his investigations on *Lygæonematus erichsonii* which were made immediately after the latter insect had been discovered as a forest pest in the United States and Canada. He says :

"A number of cocoons sent us in 1882 by Mr. Atkins were found to be in every case tenanted by a minute chalcid parasite, belonging to the genus *Pteromalus*. If new it may be called *Pteromalus nematicida* (Plate XII, Fig. 8). About a hundred of these issued from the cocoons in the breeding-box during May, 1883. This parasite must, therefore, be a most destructive enemy of the larch worm."

Beyond the figure of the parasite, which is given and again reproduced with the above account in the Fifth Report of the United States Entomological Commission (1890), no further description is given. From the correspondence printed in this account of the injuries of the sawfly it would appear that Mr. Charles F. Atkins collected the aforementioned cocoons in Maine.

No further description of this insect, so far as I am aware, has been published since Packard provisionally named it.

*Contributions from the Division of Entomology, Ottawa.

†In "The Report of the Entomologist," "Ann. Rept. of the Commissioner of Agriculture, 1883," Washington, D.C., pp. 138-142.

Cocoons of *L. erichsonii* were collected in the larch section of the forest belt at the Central Experimental Farm, Ottawa, in May, 1910, and on May 21st, a few days after bringing them into the laboratory, 25 specimens of the Chalcid emerged; 22 specimens did not emerge, but were dissected out. A careful examination of the parasite indicated its similarity on the whole, but not entirely, to Packard's figure already mentioned. This was kindly confirmed by Mr. C. T. Brues, of the Bussey Institution of the Harvard University, who placed it in Förster's genus *Cælopisthia*. The occurrence of this parasite was discussed with Mr. W. F. Fiske, in charge of the Gipsy Moth Parasite Laboratory, Melrose Highlands, Mass., who also examined cocoons of *L. erichsonii* collected at Wellesley, Mass., and found the pupæ of this parasite in these cocoons on July 28th. Mr. Fiske arranged for cocoons to be collected for me from the same locality, and these were received on September the 13th. At this time practically all the larvæ of *L. erichsonii* have gone underneath the turf and have formed cocoons and are thus prepared for hibernation. It was upon this material that most of the following observations were made.

During my absence from Ottawa for several weeks, Mr. G. E. Sanders kept the records, and he has also drawn up the description of the adult at my request, which assistance I wish to gratefully acknowledge.

DESCRIPTION OF THE ADULT.

Cælopisthia nematicida Pack.

Female (Fig. 19).—Length, 1.7 to 2.1 mm. Average length of ten specimens, 1.92 mm. Colour black; the head and thorax closely and evenly reticulate, slightly hispid, giving strongly metallic dark green reflections; the abdomen black, smooth and glossy; antennæ non metallic, the scape and pedicel brown, the flagellum darker brown; coxæ for the most part black with a green metallic lustre, tips slightly brown; legs non-metallic pale-brown, femora fuscous; wings hyaline, venation pale-brown; eyes dark, variable somewhat, but usually giving a purplish reflection.

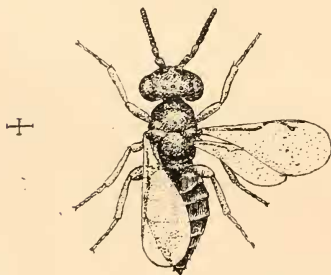


FIG. 19.—*Cælopisthia nematicida* Pack., female, $\times 12$.

Head (anterior aspect), broadly oval; antennæ inserted on an imaginary line drawn from base to base of the eyes; face broadly depressed along scapes; clypeus twice as wide as long, immarginate, notched in

centre ; (lateral aspect), genal sulcus absent, cheek slightly shorter than the eyes, full ; eyes oval, very slightly narrowed ventrally ; (dorsal aspect), head twice as wide as long, wider than the thorax, slightly narrowed behind the eyes ; occiput immarginate, strongly concave ; ocelli arranged on an obtuse angled triangle, the distance of the lateral ocelli from the eye being about equal to that of the lateral ocelli from each other.

Thorax : Pronotum visible from above, not so wide as the mesonotum, slightly produced into a neck forward, length about half that of the mesonotum. Mesothorax slightly more coarsely reticulated than the remainder of the thorax ; parapsidal furrow distinct for half the length of the mesonotum, anterior margin rounded ; axillæ produced forward to a line drawn from tegula to tegula not meeting by half their width ; scutellum rounded, full, slightly more than half the length of the thorax ; post-scutellum narrow, strongly margined. Metathorax shorter than the scutellum, angular posteriorly ; spiracles broadly oval ; sulci absent ; lateral carinæ well marked ; median carina present ; articulation with abdomen high margined ; a distinct circular depression on either side and near to the articulation.

Abdomen : Broadly ovate, as long as thorax, greatest width at segments 3-4, subsessile ; ovipositor slightly exerted ; first visible segment the longest, about one and a half times as long as the second, the five following subequal.

Wings : Hyaline, submarginal vein slightly longer than one-third of the wing ; marginal vein the same thickness as the submarginal, as long as one-quarter of the wing ; postmarginal and stigmal veins short, subequal, the stigmal vein ending in a short knob, the knob having a short process directed towards the tip of the postmarginal vein.

Antennæ : Pubescent throughout, 13-jointed including the two ring-joints, the scape reaching almost to the median ocellus, moderately slender ; the pedicel one and a half times as long as any of the flagellar joints, obconic ; flagellar joints longer than thick, subequal, slightly and regularly clavate.

Mandibles : Brownish yellow, similar, each quadridentate.

Male.—Average length, 1.6 mm. Colour similar to female, reflections brighter green mixed with purple. Penis exerted. Antennæ shorter, more compact, joints of flagellum shorter than broad and more pubescent.

LIFE-HISTORY.

The development of the last and overwintering brood was studied. Females were observed ovipositing on September 13th. The time occupied in the process varied. A single female, which was isolated for observation, remained in the same position for $1\frac{1}{2}$ hours (see Fig. 20) with her ovipositor inserted in the cocoon. She then removed her ovipositor and walked away, moving about for twenty minutes, after which she returned and inserted her ovipositor in almost the same spot as before and remained in this position ovipositing for fifty-five minutes.



FIG. 20.—Female *C. nematocida* ovipositing on cocoon of *Lyzwonematus erichsonii* Hartig, $\times 2\frac{1}{2}$.

In several instances two females were seen ovipositing in the same cocoon. The numerical abundance of the eggs that may be deposited in a single cocoon may be judged from the fact that in one case eighty-one eggs were counted on a single larva; in another case forty-seven pupæ and adults were contained in a single cocoon. The sawfly larvæ in cocoons in which the chalcids had deposited eggs appeared less active than those in uninfected cocoons; this may be due possibly to some paralysing action on the part of the female when ovipositing.

The eggs are .3 mm. in length and transparently white. In shape they are ovally elongate, having one end broader than the other, and are slightly curved (Fig. 21). They are deposited externally upon the larva,



FIG. 21.—Interior of anterior end of cocoon of *L. erichsonii*, showing eggs of *C. nematocida* deposited on the sawfly larva, $\times 15$. Also single egg of *C. nematocida*, $\times 30$.

chiefly in the anterior and thoracic region and appear to be laid in masses

with no attempt at placing them, were this possible. In three days all the larvæ had hatched from eggs deposited by females on September 13th.

The larva, when newly emerged, is transparent and vitreous in appearance.

In the breeding experiments considerable difficulties were encountered owing to the prevalence of the entomophagous fungus, *Isaria farinosa* (Dicks) Fr., which repeatedly attacked the sawfly larvae under observation. This caused the chalcid larvae to cease feeding and leave the host usually one or two days before the fungus was observed. On this account no observations of a continuous nature could be made upon the same chalcid larvae. Nevertheless, the observations were made upon larvae which emerged from eggs all deposited on the same dates, namely, September 13th and 14th, on cocoons which were separated and kept under observation. They belonged, therefore, to the same series of larvae, and the observations will be given as if they appertained to the same larvae, which, under the circumstances, is permissible.

Sept. 18.—Two days after emerging from the eggs the larvae were all
1910. feeding, being attached to the host larva by their heads in leech-like manner. For a day or two they did not appear to leave the place of original attachment.

Sept. 21.—Several larvae had moved their positions, one being attached to the eye of the host larva.

Sept. 27.—Two larvæ from one of the cocoons left the cocoon and travelled one or two centimetres from the cocoon. They were replaced in the cocoon, but had evidently ceased feeding, although another larva in the same cocoon had its head still buried in the side of the host.

Subsequent observations and examination indicated that these larvæ were full grown. The larvæ may become mature, therefore, in about twelve days.

Oct. 9.—The larvæ were still in the cocoons, full grown and not feeding. They hibernate apparently as full-grown larvæ in the cocoons of the host.

Mar. 3.—Four of the hibernating larvæ had pupated, but several larvæ
1911. still remained unchanged.

Apr. 21.—Two adult chalcids emerged.

This would make the time of development of the over-wintering brood about seven months, under experimental conditions. Passing the

winter in this manner the parasite occupies that portion of the year, during which the climatic conditions would prohibit its activities in the way of attacking fresh cocoons, were it able to produce more broods.



FIG. 22.—Full-grown larva of *C. nematocida*. $\times 12$.

The Larva.

The full-grown larva (fig. 22), measures 2.35 mm. in length. It is white, and the body, which consists of thirteen segments, has the

dorsal side more strongly convex. The larva feeds externally, usually with its head buried in the side of the host.

Number of Broods.

As it is not found possible in these experiments to follow the development of a single line of the parasites through the year, exact statements as to the number of broods during the season cannot be made at present. I believe, however, that it is safe to make inferences from the observations which were made on material collected in Massachusetts and in Canada. In one batch of cocoons, adults emerged on October 9th from cocoons in which eggs had been deposited on September 13th to 16th, from which it would appear that the time of development of a summer brood was about 23 days. It has been found that the females oviposit shortly after emergence, so that no lengthy period necessarily intervenes between the development of the broods if the parasite can find healthy cocoons of the sawfly.

The prevalence of healthy cocoons of the host would determine the efficiency of the parasite. It has been found in studying the life-history of the host *L. erichsonii* that the sawfly larvæ may become full grown and form the cocoons as early as June 12th to June 17th, which would mean that in any year cocoons of that year's sawfly larvæ could be found from the middle of June. Further, it has also been found that sawflies will continue to emerge from the cocoons of the larvæ of the previous year until the end of June, which indicates that there is a supply of the previous year's larvæ in their cocoons until the first or second week in June. In short, it has been found that cocoons containing larvæ of *L. erichsonii* may be found throughout the whole year, the time of least abundance being in June. It may be assumed, therefore, that if the Chalcid can find healthy cocoons, and this has been shown to be possible during the whole of the year, the production of broods may continue throughout that portion of the year during which the climatic conditions

permit the activity of the Chalcids. From my observations on the emergence of the Chalcids, this is from the latter part of May to the beginning of October, namely, about five months. On the basis of these facts, there is sufficient time for the development of about six broods during the open season; assuming that healthy cocoons are available on the emergence of the adult Chalcids. The cocoons are usually so located under the turf, as to be readily accessible to these small Chalcids, which, on emerging from one cocoon, would soon seek a healthy host. It would seem, therefore, from the study of the parasite and from such evidence as I have been able to collect concerning the history of the prevalence of its host in certain localities, that this species is one of the chief factors in the natural control of *L. erichsonii* wherever the Chalcid occurs.

Summary.

In the observations which were made on the development of the Chalcid *Cælopiethia nematicida*, it was found that in the September and October broods the eggs, which are laid on the host larvæ inside the cocoons, hatch in two to three days; the larvæ become full grown in ten to twelve days, and the adults may emerge about twenty-three days after the eggs were deposited. The parasite feeds externally and hibernates as a mature larva inside the cocoon of the host. A number of broods of the parasite occur annually.

ON THE HABITS AND STRIDULATION OF *IDIONOTUS BREVIPES* CAUDELL, AND OTHER NOTES ON ORTHOPTERA.

BY E. M. WALKER, TORONTO, ONT.

Since recording the capture of the northern Dectician, *Idionotus brevipipes* Caudell, at Fort William, Ont. (CAN. ENT., XL, p. 209), I visited the same locality again in 1910, and succeeded in finding the insect a second time, on the second and eighth of August.

I found that it is by no means confined to open grassy places, as I had supposed, but occurs also in paths and old lumber roads in the depths of the spruce swamps, which still cover the greater part of the flat country surrounding Fort William and Port Arthur. The tree growth in these swamps consists mainly of black spruce, interspersed with tamarack, white cedar and balsam fir.

With the exception of a single female, which I found squatting close to the ground on a path in the swamp, all the specimens taken were males,

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